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W. L. R. EMMET & O. JUNGGREN.

VALVE FOR INTERMEDIATE STAGES OF TURBINES.

APPLICATION FILED SEPT. 19, 1903.

2 SHEETS—SHEET 1.

Fig. 1.

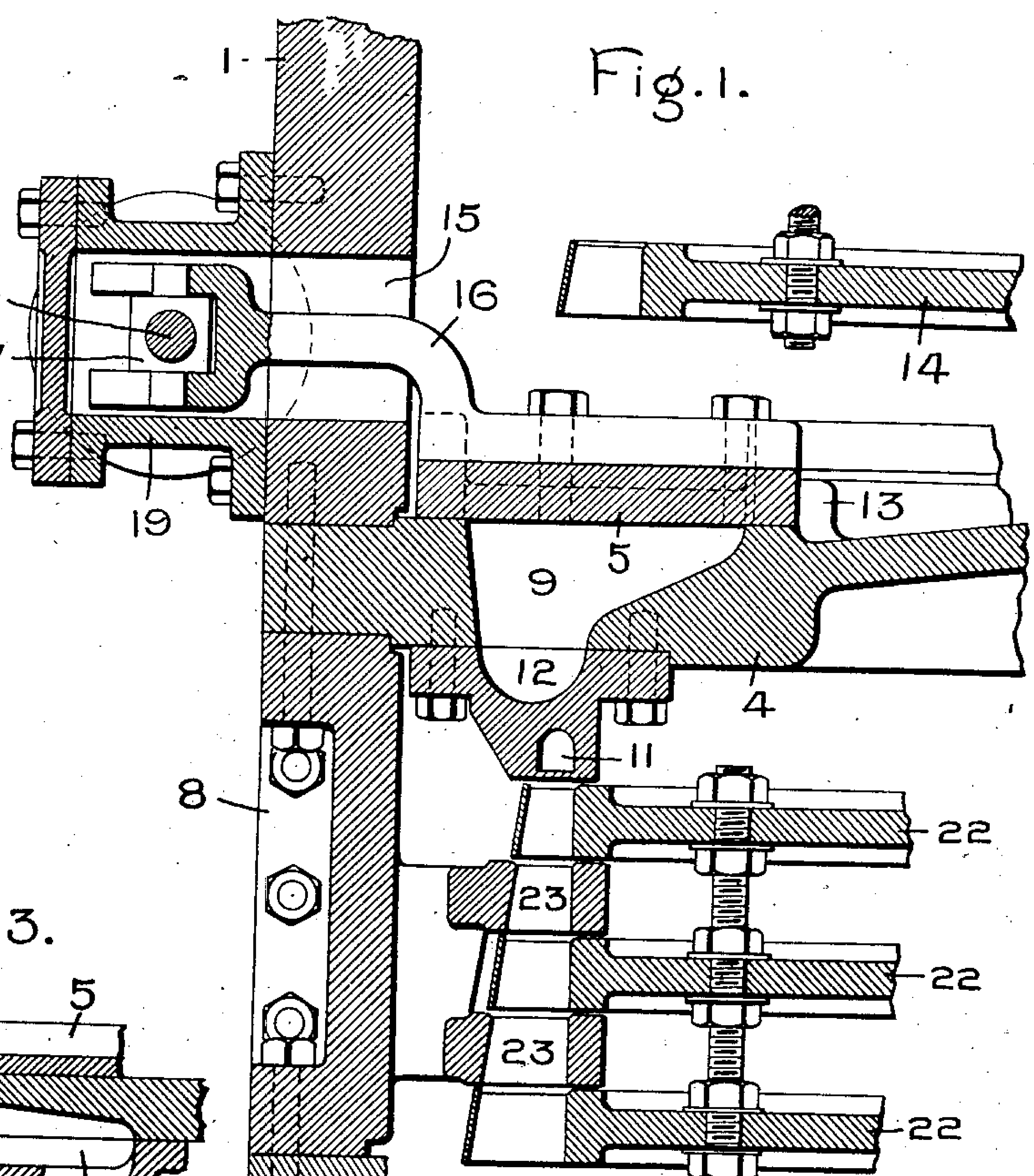


Fig. 3.

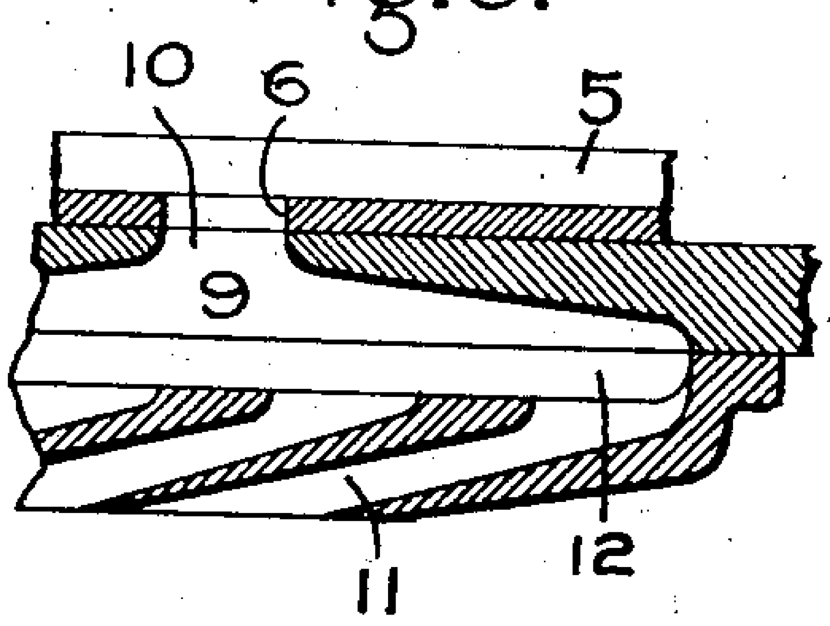
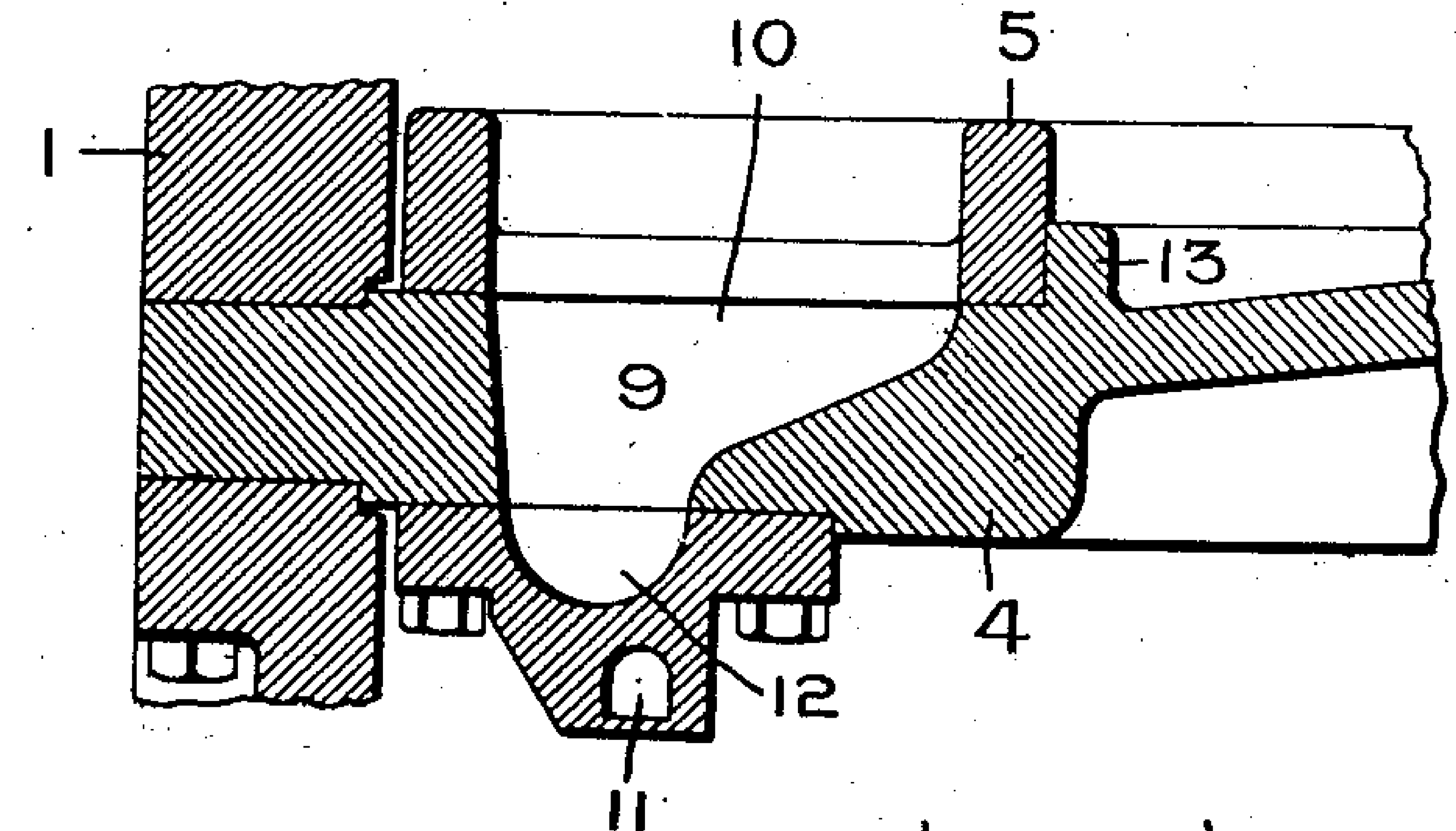


Fig. 2.



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2 SHEETS—SHEET 2.

Fig. 5.

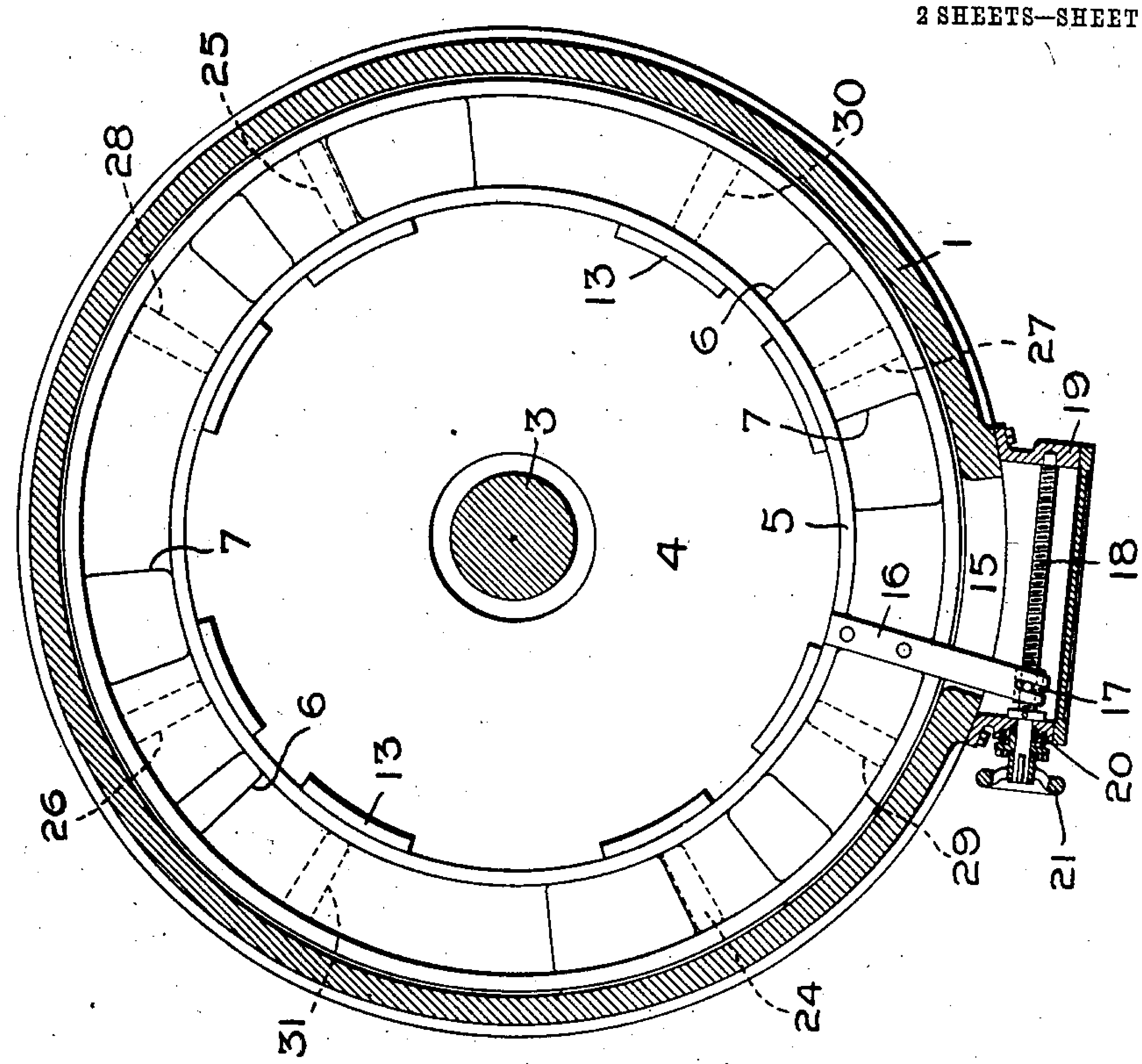
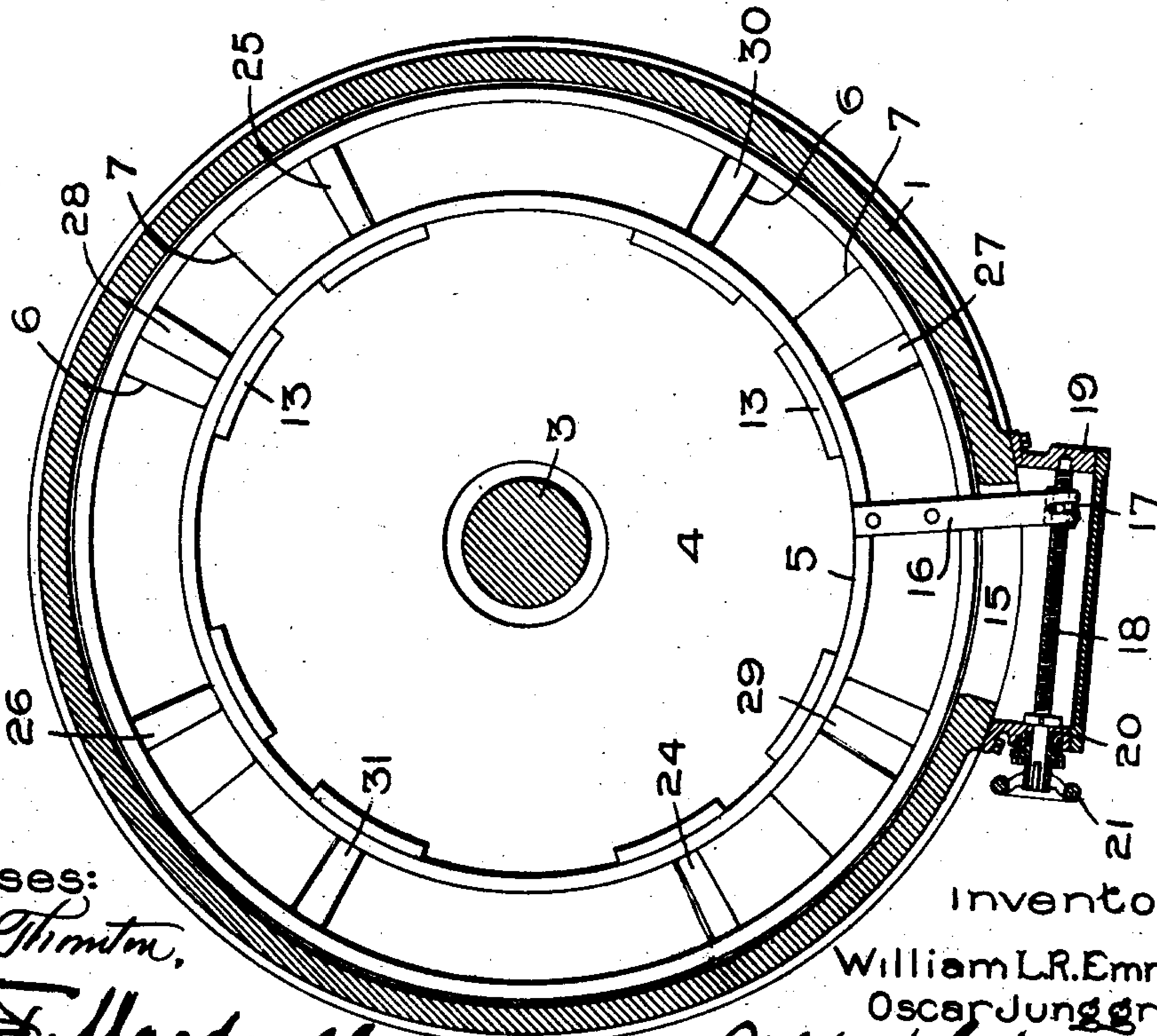


Fig. 4.



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No. 779,840. Patented January 10, 1905.

UNITED STATES PATENT OFFICE.

WILLIAM L. R. EMMET AND OSCAR JUNGGREN, OF SCHENECTADY, NEW YORK, ASSIGNORS TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

VALVE FOR INTERMEDIATE STAGES OF TURBINES.

SPECIFICATION forming part of Letters Patent No. 779,840, dated January 10, 1905.

Application filed September 19, 1903. Serial No. 173,844.

To all whom it may concern:

Be it known that we, WILLIAM L. R. EMMET and OSCAR JUNGGREN, citizens of the United States, residing at Schenectady, in the county of Schenectady and State of New York, have invented certain new and useful Improvements in Governing-Valves for Intermediate Stages of Elastic-Fluid Turbines, of which the following is a specification.

In order to obtain the highest possible efficiency in an elastic-fluid turbine of the jet or impact type having two or more stages, each stage should be provided with a valve mechanism for regulating the volume of steam or other motive fluid delivered to the adjacent wheel or wheels of lower pressure. The valve mechanism should be so arranged that the nozzles or nozzle-sections can be cut into or out of service without throttling the flow of motive fluid through any particular nozzle or nozzle-section, since throttling can only take place at a loss of efficiency.

The object of the present invention is to provide a simple valve mechanism whereby the nozzles or nozzle-sections of the intermediate stages of an elastic-fluid turbine can be cut into and out of service without throttling, and this with a minimum expenditure of labor.

The sectionalized nozzles of the intermediate stages in a multistage turbine cover the larger portion of the wheel circumference, so that the spaces between them measured circumferentially are of less length than the nozzles themselves. A valve which is common to all of the nozzles is preferable, owing to the simplicity of construction; but since the nozzles cover the greater part of the wheel circumference it follows that unless special provision be made the ports controlling one group or section of the nozzles will overlap those of a second group while the valve is being moved between extreme positions. We bolt or otherwise secure the sectionalized nozzle to the walls or diaphragm between adjacent stages, and the bowls thereof communicate with a chamber formed in the walls or diaphragm. This chamber has a special form. On the side adjacent to the nozzles it has a circumferential length equal to the space covered by the nozzle-bowls, and measured radially it has a width equal to the diameter of a bowl. These dimensions may be changed, however, to suit requirements without departing from our invention. On receding from the bowls the shape of the chamber changes rapidly, so that at the throat or receiving-opening it has a small circumferential length; but the width measured on a radius is much greater than before. In fact, the width is much greater than the length. By this arrangement the fluid-carrying passages leading to the nozzles may be widely spaced, while the nozzles themselves may closely approach each other or, in fact, touch. The cross-sectional area of the throat leading to the chamber should be made as small as possible consistent with the volume of fluid to be handled, since by so doing the effective pressure on the valve is reduced to a minimum.

Operatively mounted with respect to the throat of the chamber is a ring valve, which is operated by means exterior to the wheel-casing. In the present illustration the valve is actuated by hand; but it may be accomplished automatically. In the valve are openings corresponding in number to the groups of nozzles or nozzle-sections. The nozzles and openings in the valve may be arranged in different ways to suit the requirements of the machines.

We have found it advantageous to arrange the nozzles or nozzle-sections in pairs and to locate them at diametrically opposite points. The valve is provided with ports or openings which are adapted to admit or cut off fluid to the nozzles. As arranged in the present embodiment of our invention, all of the second-stage nozzles can be cut out of service, or they may be all cut into service successively, as desired. The first position of the valve cuts two nozzles or nozzle-sections into service. The second position adds two more nozzles, the third two more, and the fourth and last position adds two more nozzles or nozzle-sections, making eight in all. The nozzles can with advantage be made separate from the liaphragm; but it is within the scope of our invention to make them a part thereof.

In the accompanying drawings, which represent one embodiment of our invention, Figure 1 is a partial vertical section of an impact-turbine. Fig. 2 is an enlarged detail sectional view of the valve and a second-stage nozzle. Fig. 3 is a sectional detail through the nozzle and valve at right angles to that of Fig. 1. Fig. 4 is a plan of the valve, showing all of the nozzles or nozzle-sections in the open position; and Fig. 5 is a similar view with a valve moved to a position where all of the nozzles are closed.

Referring to Figs. 4 and 5, 1 represents the casing of a multistage turbine with the nozzles arranged in pairs, the nozzles of each pair being situated diametrically opposite. In the present illustration these nozzles are arranged in pairs or groups of two; but the number can be varied without departing from our invention. 3 represents the shaft of the bucket-wheel, which passes through the diaphragm 4. Mounted on the diaphragm, and preferably on the high-pressure side, is a ring valve 5, having as many groups of ports or openings as there are groups of nozzles. In the present embodiment of the invention these ports are of two sizes. The smaller of the ports is designated by the numeral 6 and the larger by the numeral 7. These ports are so arranged in the ring valve that corresponding ports are diametrically opposite. By this arrangement when the valve is rotated the corresponding nozzles on opposite sides of the wheel will be cut into or out of service, depending upon the direction of rotation, and the strains upon the wheels are equally distributed.

As shown in the drawings, there are eight groups of nozzles, each nozzle having a number of sections, and the valve is so arranged that when in the position shown in Fig. 4 all of the nozzles are active. When the valve is rotated to the position shown in Fig. 5, all of the nozzle-sections are rendered inoperative.

Referring to Fig. 1, 1 represents the upper part of the wheel-casing and 8 the lower. These casings may be constructed in any suitable manner. Between the parts of the casing and engaging therewith is a diaphragm 4, which is provided with as many chambers 9 as there are groups of nozzles. Each of these chambers is provided with a throat or neck 10, which is relatively short, measured circumferentially, and relatively wide, measured radially, as is shown in Figs. 2 and 3. From the throat the chamber gradually changes in form to cover all of the nozzle-bowls, so as to supply motive fluid to the several nozzles or nozzle-sections 11. Each of the nozzles is bolted to the under side of the diaphragm, and the chamber 12 therein registers with the chamber 9 of the diaphragm. The chambers 9 and 12 constitute, in effect, a single chamber, which serves to properly distribute the motive fluid to the nozzles. The upper surface of the diaphragm is turned off true, and resting thereon and held in place by its own weight and by the pressure of the fluid within the first wheel-casing is a valve 5. The valve is guided in its motions by the projections 13, which are carried by the diaphragm 4 and may be made integral therewith or separate therefrom, as is desired.

The casing for the first-stage wheel 14 is slotted at 15, and projecting therethrough is an arm 16, that is bolted to the upper side of the valve. The outer end of the arm is provided with a fork in which is pivotally supported a nut 17, the latter engaging with a screw-threaded spindle 18 for moving the valve. The spindle is supported at its ends in the walls of casing 19, which is secured to the wall of the main casing. One end of the spindle is seated in a bearing located entirely within the casing and the other end passes through the casing and is provided with a packing 20 to prevent the escape of fluid. On the end of the spindle is a hand-wheel 21 for rotating it in the desired direction. In the present embodiment of the invention the spindle is rotated by hand; but the invention is not to be construed as being limited to the arrangement shown, since other means may be employed to accomplish the same purpose.

In Fig. 1 three wheels 22 are shown in the second stage, and between the adjacent wheel-buckets are rows of intermediate buckets 23, which may be stationary or rotary, as is desired. In the present embodiment they are shown as being stationary and carried by the sectional casing 8. The nozzle 11 is sectionalized and is commonly, although not necessarily, of the expanding type, and the motive fluid issues therefrom in the form of a solid column or belt. The working passage formed between the buckets expands from the receiving toward the discharge end, and the velocity of the fluid stream due to the expanding nozzle is abstracted in successive operations by the bucket-wheels. By adjusting the ring valve the necessary shell-pressure to obtain maximum economy in the first stage is obtained. Ordinarily the valve is set to maintain the proper first-stage shell-pressure at full load, and for ordinary load changes the valve need not be disturbed. At very light load a partial vacuum exists in the first stage, and the wheels will then operate in a medium of lower density than normal.

Referring to Figs. 4 and 5, 24 and 25 represent the first groups of nozzles to be cut into or out of service; 26 and 27, the second; 28 and 29, the third, and 30 and 31 the fourth.

Under certain conditions we may apply our invention to the primary stage of a turbine, and we aim to embrace such a use in the claims.

In accordance with the provisions of the patent statutes we have described the principle of operation of our invention, together with the apparatus which we now consider to represent the best embodiment thereof; but we desire to have it understood that the apparatus shown is only illustrative and that the invention can be carried out by other means.

What we claim as new, and desire to secure by Letters Patent of the United States, is—

1. In a turbine, the combination of a plurality of nozzles or nozzle-sections arranged in groups, a distribution-chamber anterior to each group which supplies it with motive fluid, and a valve that is common to all of the chambers and groups of nozzles or nozzle-sections for controlling the passage of fluid therethrough.

2. In a turbine, the combination of a plurality of nozzles or nozzle-sections arranged in groups, a distribution-chamber anterior to each group for supplying it with fluid, the said chamber having a throat, the radial dimension of which is greater than the circumferential dimension, and a valve having ports or openings of different size formed therein, which is common to all of the chambers and controls the passage of fluid thereto.

3. A turbine comprising a casing, wheels mounted therein and subjected to different pressures, and a diaphragm between the wheels, in combination with sectionalized nozzles attached to the diaphragm, distribution-chambers formed in the diaphragms and anterior to the nozzles, and a valve which is mounted directly on the diaphragm and is common to the chambers.

4. A turbine comprising a casing, wheels mounted therein and subjected to different pressures, and a diaphragm between the wheels, in combination with sectionalized expanding nozzles attached to the diaphragm, distribution-chambers formed in the diaphragms anterior to the nozzles, each being provided with a throat, the radial dimension of which is greater than the circumferential dimension, and a valve common to said chambers which is mounted on the diaphragm and is provided with ports or openings of different size.

5. A turbine comprising a slotted wheel-casing, a diaphragm between adjacent wheels, and nozzles for imparting motion to the motive fluid and discharging it against the adjacent wheel, in combination with a distribution-chamber in the diaphragm anterior to the nozzles, a valve mounted on the diaphragm, an arm extending through the slot, a casing which closes in the arm and the slot, and a screw and nut for moving the valve by means of the arm.

6. In a turbine, the combination of a plurality of nozzles distributed around a wheel, a distribution-chamber anterior to each nozzle which supplies it with motive fluid, and a valve that is common to all of the nozzles and chambers for controlling the passage of fluid therethrough.

7. An elastic-fluid turbine comprising bucket-wheels and nozzles for delivering fluid thereto which cover the larger portion of the bucket-surface, in combination with chambers for supplying motive fluid to the nozzles, each chamber covering the bowls of the adjacent nozzle and having a receiving-throat that has a lesser circumferential dimension than radial, and valve mechanism for covering and uncovering the throats.

In witness whereof we have hereunto set our hands the 12th and 16th days of September, 1903.

WILLIAM L. R. EMMET.
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